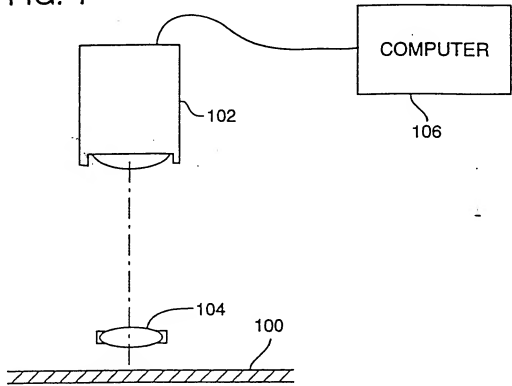
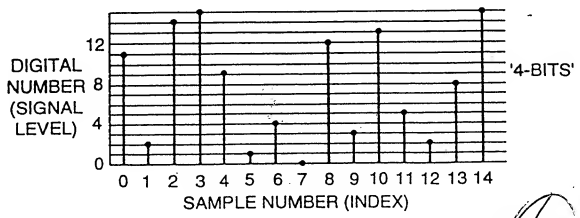


FIG. 4



→ EXPOSE AND STEP

FIG. 1



(B)

FIG. 2

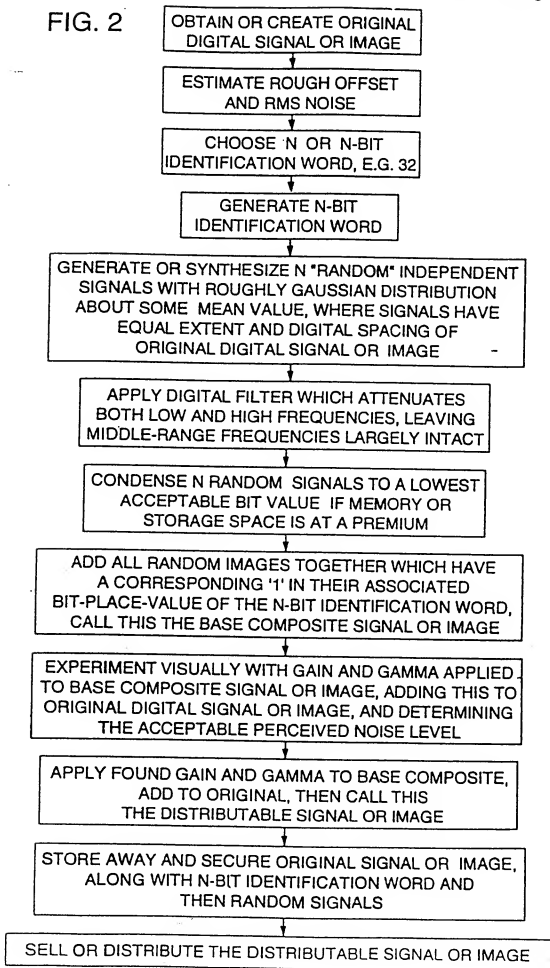
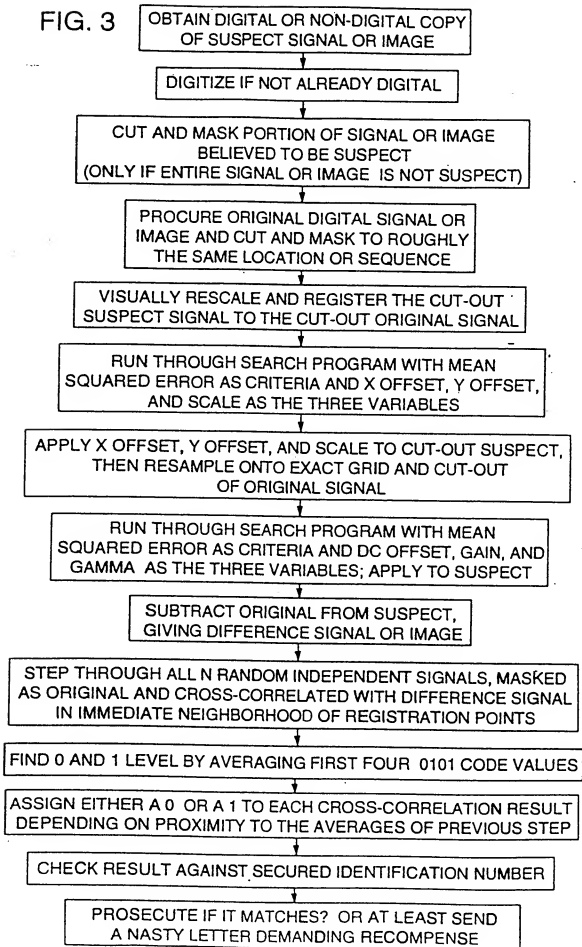


FIG. 3



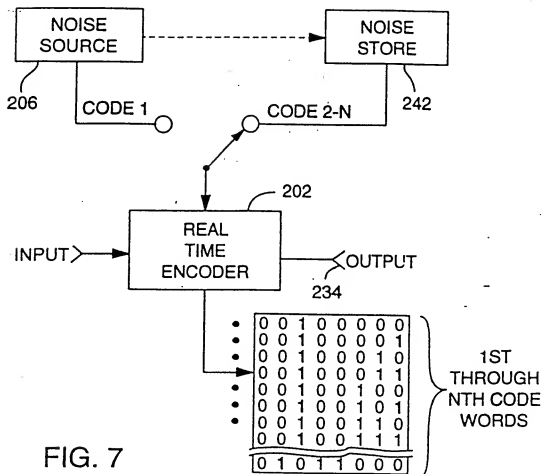


FIG. 7

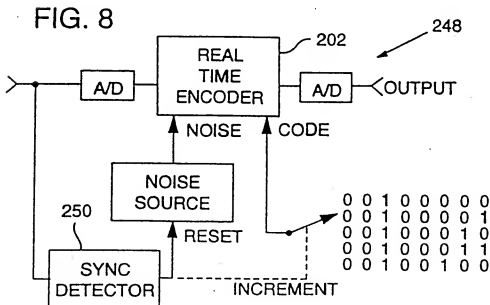


FIG. 8

FIG. 9A

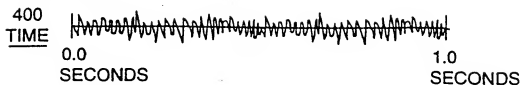


FIG. 9B

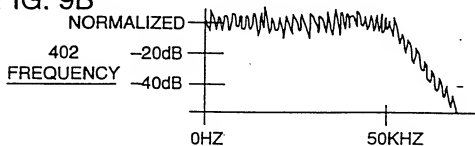


FIG. 9C

BORDER
CONTINUITY
404

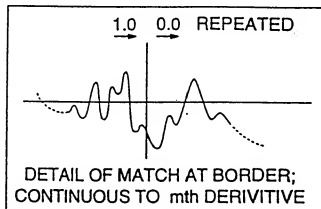


FIG. 10

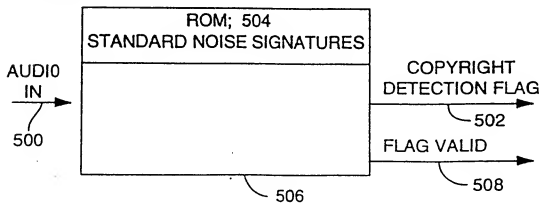


FIG. 11

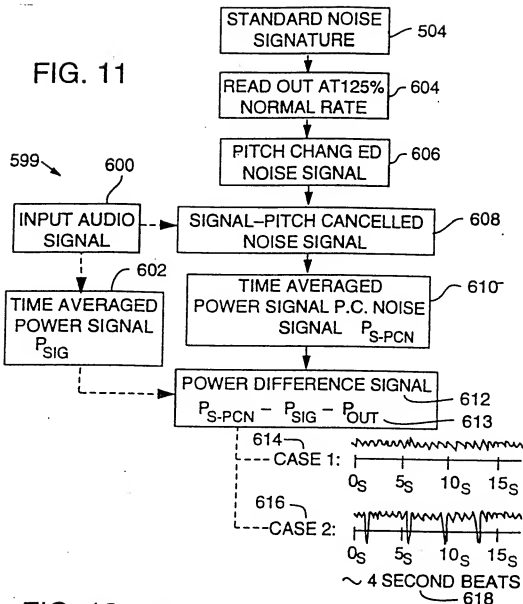


FIG. 12

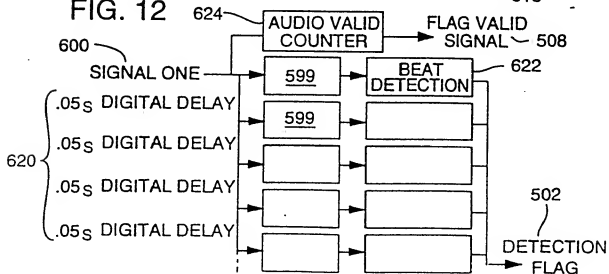
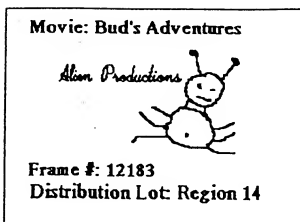


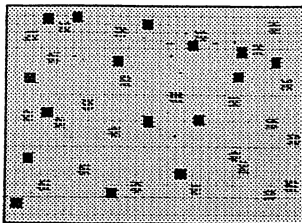
Figure 13



700



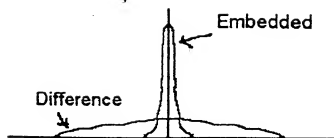
Encryption/Scrambling
Routine # 28 ,702



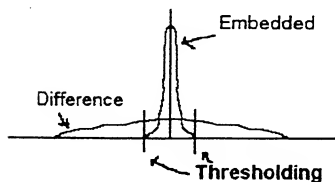
704

Pseudo-Random Master Snowy Image
(Scaled Down and Added to Frame 12183)

Figure 14



**720, Mean-Removed Histograms of
Difference Signal and Known Embedded
Code Signal**



**722, Mean-Removed Histograms of
First Derivatives (or scalar gradients
in the case of an image)**

Figure 15

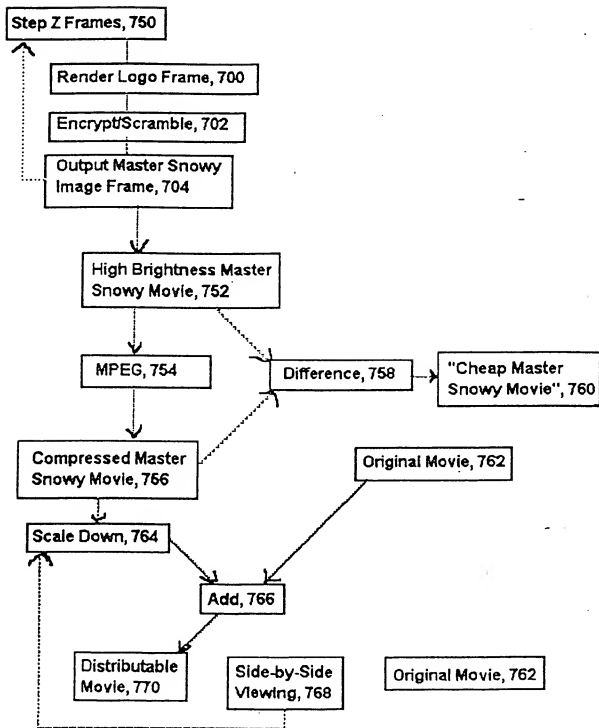
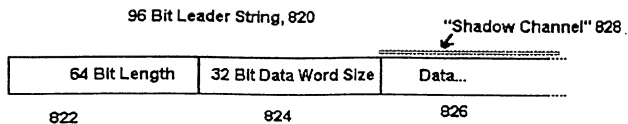
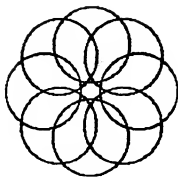


Figure 17

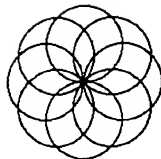


Universal Empirical Data Format

Figure 18



Supra-radial Knots, 850



Radial Knots, 852

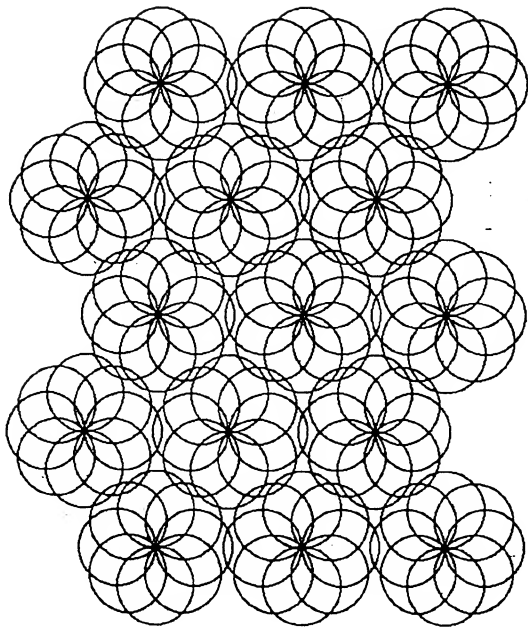


854, One basic concept of the knot is an overlapping of
one strand of finite width over another strand



864, Another basic concept is the symmetric weaving of overlaps

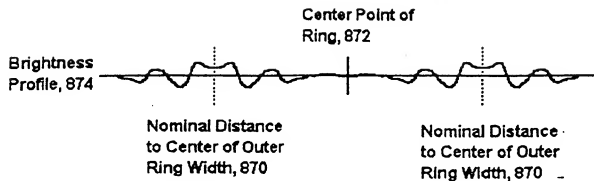
Figure 19



866, Quest for Mosaicd Knot Patterns which "Cover" and are Coextensive with Original Image;

All elemental knot patterns can convey the same information, such as a signature, or each can convey a new message in a steganographic sense

Figure 20



876, 2-D brightness of phase-only filtered ring is similar to the above brightness pattern rotated about central point of ring :



Figure 21A

C	2C	C
2C	4C	2C
C	2C	C

where $C = 1/16$

Elementary Bump, 900
(Defined grouping of pixels with
weight values)

2		3		4		5		6		7		0
6		7		0		1		2		3		4
					C	2C	C					
2		3		4	2C	4C	2C	6		7		0
					C	2C	C					
6		7		0		1		2		3		4

Example of how elementary bumps, 900, would be assigned locations in an image, and those locations would be associated with a corresponding bit plane in the N-bit word, here taken as $N=8$ with indexes of 0-7. One location, associated with bit plane "5", has the overlay of the bump profile depicted.

FIG. 21B

Figure 22

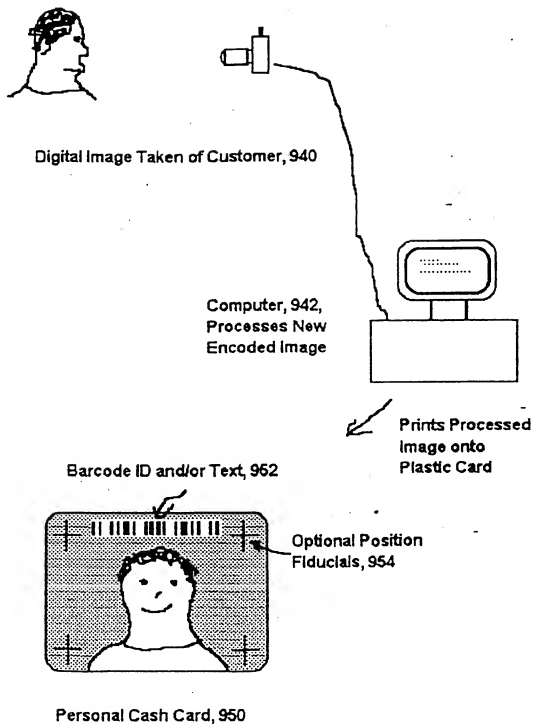
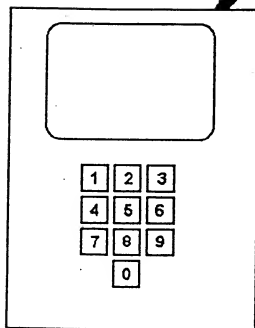


Figure 23

Optical
Window, 960

PIN
Key Punch,
962



Cable, 964,
to Data Line,
966

Low Cost Point-of-Sale Optical Reader, 958

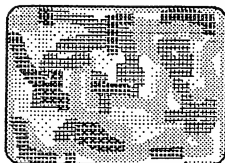
Contains rudimentary optical scanner,
memory buffers, communications devices,
and microprocessor

Consumer merely places card into window and can, at their pre-arranged option, either type in a Personal Identification Number (PIN, for added security) or not. The transaction is approved or disapproved within seconds.

Figure 24



Original Digital Image with
Barcode and Fiducials
Added, 970



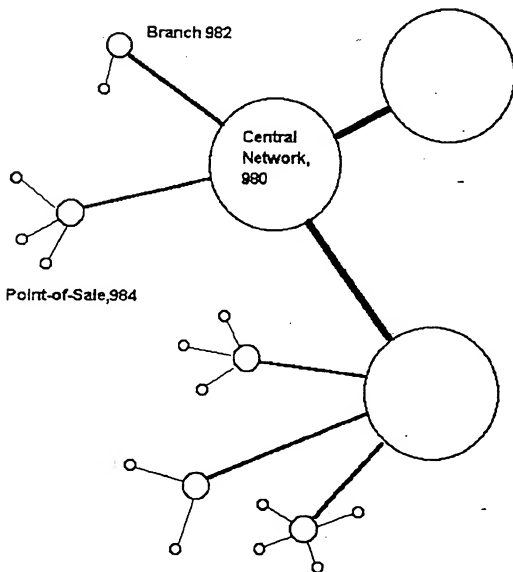
Computer generates Master
Snowy Image 972, which is
generally orthogonal to
Original Image at left



Combined to form Personal Cash Card, 950

Figure 25**Typical Transaction Steps**

1. Reader scans images on card, stores in memory, extracts persons ID
2. Optional: User keys in PIN number
3. Reader calls central account data network, handshakes
4. Reader sends ID, (PIN), merchant information, and requested transaction amount to central network
5. Central Network verifies ID, PIN, Merchant info, and account balance
6. If OK, Central Network generates twenty four sets of sixteen distinct random numbers, where the random numbers are indexes to a set of 64K orthogonal spatial patterns
7. Central Network transmits first OK, and the sets of random numbers
8. Reader steps through the twenty four sets
 - 8A. Reader adds together set of orthogonal patterns
 - 8B. Reader performs dot product of resultant pattern and card scan, stores result
9. Reader transmits the twenty four dot product results to Central Network
10. Central Network checks results against master
11. Central Network sends final approval or denial
12. Central Network debits Merchant Account, credits Card account

Figure 26**The Negligible-Fraud Cash Card System**

A basic foundation of the cash card system is a 24 hour information network, where both the stations which create the physical cash cards, 950, and the point-of-sales, 984, are all hooked up to the same network continuously

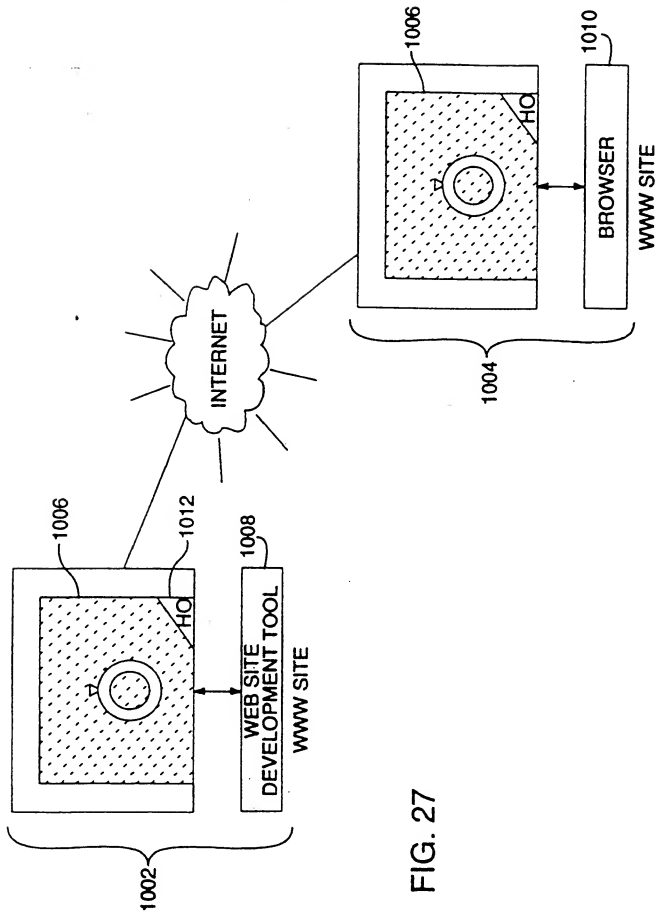


FIG. 27

FIG. 27A

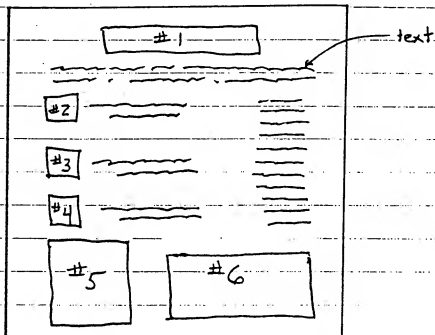


FIG. 27B

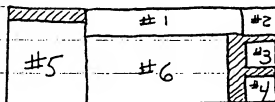


Fig. 28

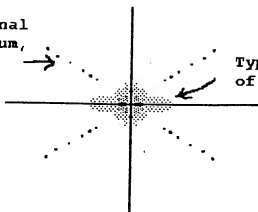


Figure 29

UV Plane, 1000

Embedded Signal
Power Spectrum,
1002

Typical Power Spectrum
of Arbitrary Image,
1004



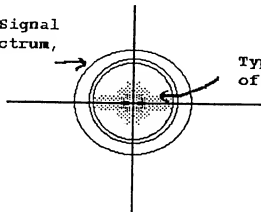
Non-harmonic spatial frequencies along the
45 degree axes, giving rise to a weave-like
cross-hatching pattern in the spatial domain

Figure 30

UV Plane, 1000

Embedded Signal
Power Spectrum,
1006

Typical Power Spectrum
of Arbitrary Image,
1004



Non-harmonic concentric circles in UV plane,
where phase hops quasi-randomly along each
circle, giving rise to pseudo random looking
patterns in the spatial domain

FIG. 29A

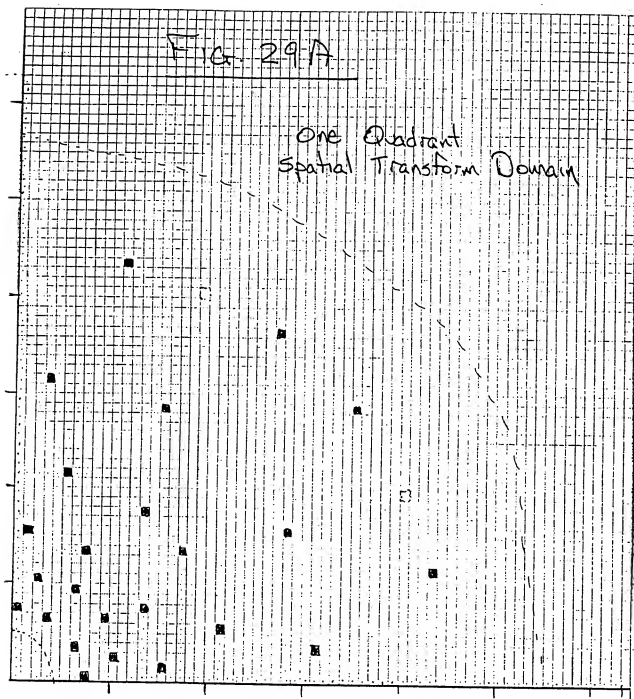


Figure 31A

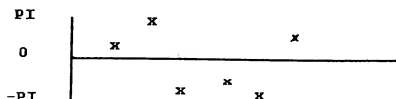
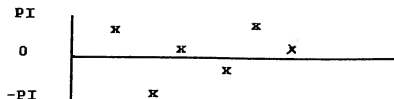


FIG. 31B

Figure 32A

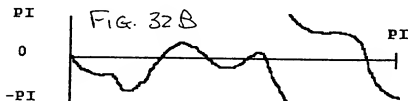
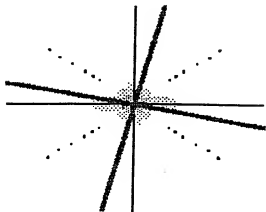
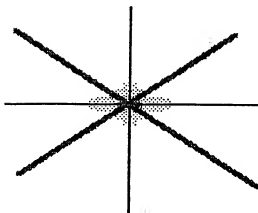


Figure 33A



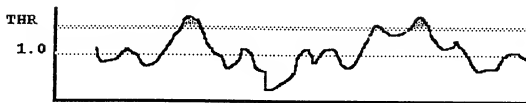
Angle A 1018

FIG. 33B



Angle B 1020

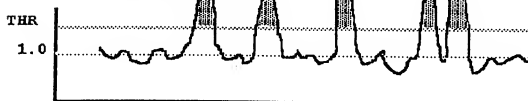
FIG. 33C



Power profile along Angle A, as normalized by its own moving average; only a minimal amount exceeds threshold, giving a small integrated value

1022

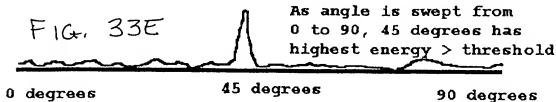
FIG. 33D



Power profile along Angle B, as normalized by its own moving average; this finds strong energy above the threshold

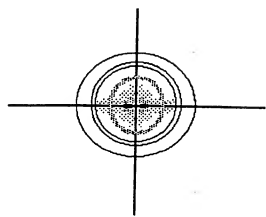
1024

FIG. 33E



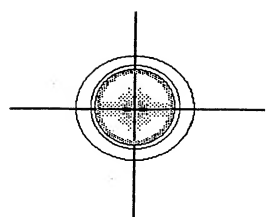
1026

Figure 34A



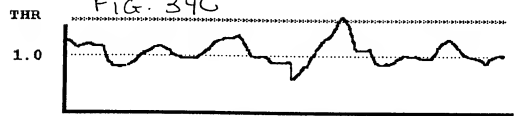
Radius A, 1028

FIG. 34B

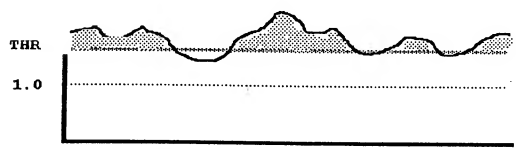


Radius B, 1030

FIG. 34C



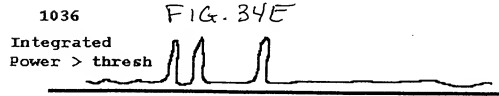
Power profile along circle at radius A, 1032



Power profile along circle at radius B, 1034

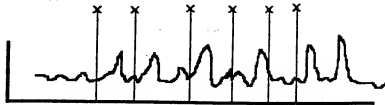
FIG 34D

FIG. 34E



Total integrated power above threshold, as function of radius 1038 radius, 1040

Figure 35A



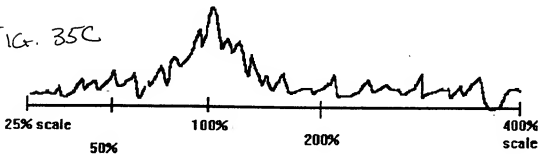
Scale = A; add all power values at the "known" frequencies, 1042

FIG. 35B



Scale = B; add all power values at the "known frequencies, 1044

FIG. 35C



"Scaled-kernel" based matched filter; peak is where the scale of the subliminal grid was found, 1046

Figure 36A

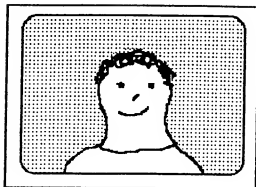
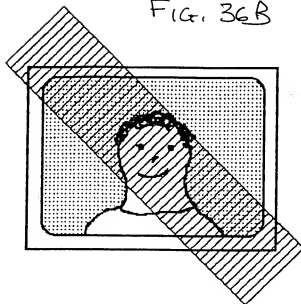


FIG. 36B



Arbitrary Original Image, 1050,
in which subliminal
graticules may have been placed

"Column scan", 1052
is applied along a
given angle through
the center of the
image

Column-
integrated
grey
values,
1054

FIG. 36C

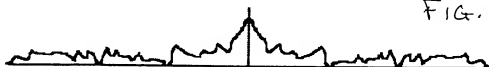
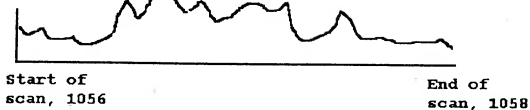


FIG. 36D

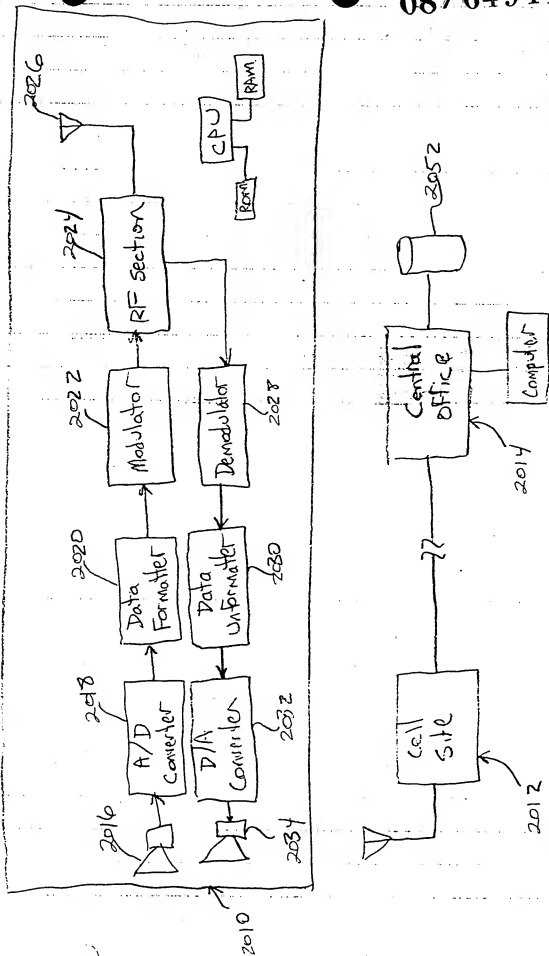
Magnitude of Fourier Transform of scan data,
1060

Figure 37

Process steps

1. Scan in photograph
2. 2D FFT
3. Generate 2D Power spectrum, filter with e.g. 3x3 blurring kernel
4. Step angles from 0 degrees through 90 (1/2 deg)
 5. generate normalized vector, with power value as numerator, and moving averaged power value as denominator
 6. integrate values above some threshold, giving a single integrated value for this angle
7. end step on angles
8. Find top one or two or three "peaks" from the angles in loop 4 , then for each peak...
9. Step scale from 25% to 400% ,step ~1.01
 10. Add the normalized power values corresponding to the 'N' scaled frequencies of standard
 11. Keep track of highest value in loop
12. end loop 9 and 8, determine highest value
13. Rotation and scale now found
14. Perform traditional matched filter to find exact spatial offset
15. perform any "fine tuning" to precisely determine rotation, scale, offset

FIG. 38



2036

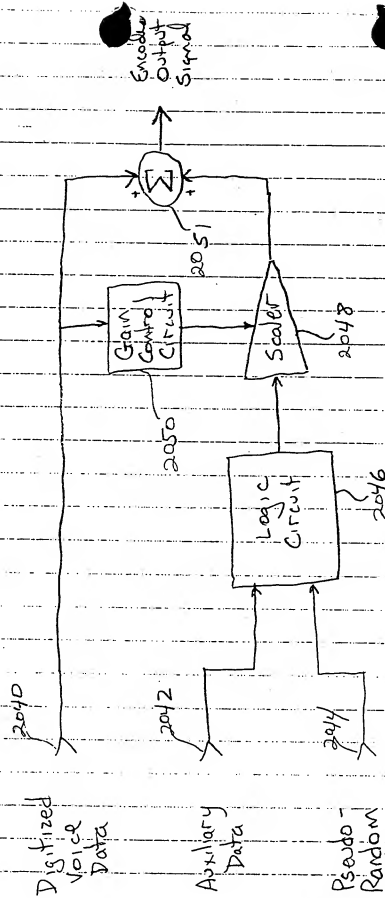
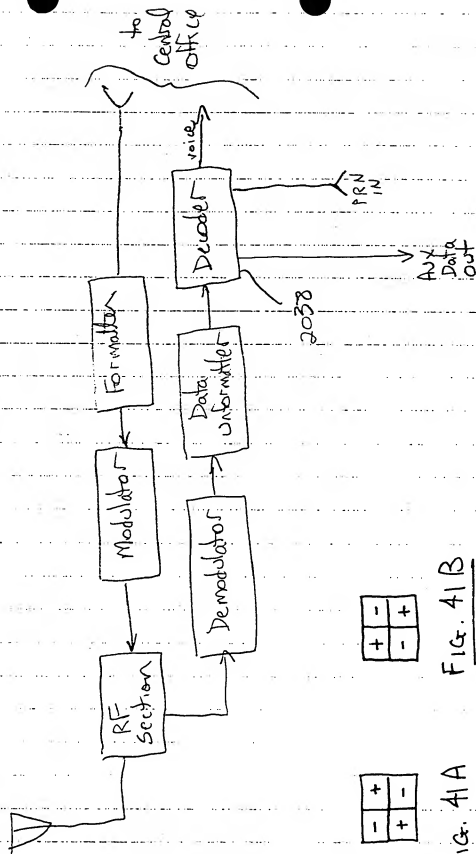


Fig. 39

Fig. 40



-	+
+	-

Fig. 41B

+	-
-	+

Fig. 41A

